

Colon Cancer Treatment: Are There Racial Disparities in an Equal-Access Healthcare System?

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BACKGROUND: In the general US population, blacks and whites have been shown to undergo colon cancer treatment at disproportionate rates. Accessibility to medical care may be the most important factor influencing differences in colon cancer treatment rates among whites and blacks.

OBJECTIVE: We assessed whether racial disparities in colon cancer surgery and chemotherapy existed in an equal-access health care system. In addition, we sought to examine whether racial differences varied according to demographic and tumor characteristics.

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DESIGN AND SETTING: Database research using the Department of Defense Military Health System.

PATIENTS: Patients included 2560 non-Hispanic whites (NHW) and non-Hispanic blacks (NHB) with colon cancer diagnosed from 1998 to 2007.

MAIN OUTCOME MEASURES: Logistic regression was used to assess the associations between race and the receipt of colon cancer surgery or chemotherapy while controlling for available potential confounders, both overall and stratified by age at diagnosis, sex, and tumor stage.

RESULTS: After multivariate adjustment, the odds of receiving colon cancer surgery or chemotherapy for NHBs versus NHWs were similar (OR, 0.75 [95% CI, 0.37–1.53]; OR, 0.79 [95% CI, 0.59–1.04]). In addition, no effect modifications by age at diagnosis, sex, and tumor stage were observed.

LIMITATIONS: Treatment data might not be complete for beneficiaries who also had non-Department of Defense health insurance.

CONCLUSIONS: When access to medical care is equal, racial disparities in the provision of colon cancer surgery and chemotherapy were not apparent. Thus, it is possible that the inequalities in access to care play a major role in the racial disparities seen in colon cancer treatment in the general population.

KEY WORDS: Chemotherapy; Colon cancer; Equal access; Race; Surgery; Treatment.

Colorectal cancer (CRC) is the third leading cause of cancer incidence and mortality among men and women in the United States.¹ The American Cancer Society estimated that 143,460 new cases and 51,690 deaths would result from CRC in 2012; the majority (72%) of these incidence cases were expected to occur in the colon.¹ Although CRC mortality rates have declined over time for both sexes among blacks and whites, racial disparities have widened and are not fully understood.^{2,3} Tumor stage at diagnosis is a strong predictor of CRC mortality; given that blacks tend to be diagnosed with later-stage CRC,⁴ racial variation in tumor stage at diagnosis likely accounts for much of the racial disparity in CRC mortality. However, within the same tumor stage, the decline in CRC mortality rate over time has been lower among blacks than whites.³ Thus, racial variations in other factors, such as cancer treatment^{5,6} and follow-up care,⁷ are likely important as well.

In the general US population, blacks and whites have been shown to undergo colon cancer treatment at disproportionate rates given the same tumor stage^{6,8} or after adjusting for tumor stage.^{5,9} Although the gap between whites and blacks in the receipt of colon cancer surgery and chemotherapy has lessened over the years, racial differences are still apparent.^{10,11} Compared with whites, blacks tend to be less likely to receive surgery^{9,12,13} and chemotherapy.^{8,9,13}

Racial disparities in treatment may be related to patient and physician characteristics, as well as factors related to the health care system.^{14,15} Although physician recommendations on treatment,^{16,17} patient knowledge and beliefs on cancer,^{18,19} patient-doctor interaction,^{20,21} and shared decision making with family and friends^{22,23} may be related to the receipt of cancer treatment, accessibility to medical care (ie, cost and location of care^{24,25} and insurance type)²⁴ may be the most important factor, because it is directly related to the availability and implementation of treatment. In the United States, blacks tend to be less likely than whites to have health insurance and more likely to be insured through government programs, thus having lower access to medical care.^{24,26–28} Therefore, black patients may be less likely to receive sufficient and timely treatment than white patients.

In an equal-access health care system, different racial/ethnic groups have the same level of access to medical care. Thus, any racial differences in the system may result from factors related to the actual use of care rather than the access. Among studies performed in an equal-access system, white and black patients with CRC were found to undergo surgery, chemotherapy, and radiation therapy at equal rates.^{29,30} In addition to the studies in equal-access systems, research in quality-seeking facilities, such as the National Cancer Institute–designated cancer centers and American College of Surgeons National Surgical Quality Improve-

ment Program hospitals, showed similar cancer outcomes between racial/ethnic groups.^{31,32} Patients who visit these facilities may have good access to care despite their race, and the similar outcomes might result from similar treatment between whites and blacks.

The US Department of Defense (DoD) Military Health System (MHS) provides equal medical care to all of its beneficiaries, regardless of racial background; therefore, the MHS offers an excellent environment to assess whether racial differences in cancer treatment exist given equal access to care. A recent study by Hofmann et al²⁹ found no differences in colon cancer treatment between whites and blacks who were treated at DoD facilities. However, several issues that may have affected the results should be investigated further. First, treatment data, which were ascertained from the cancer registry only, may have been incomplete, because treatment that occurs multiple months after diagnosis might be underdetermined; the use of medical claims data in conjunction with registry data may provide more complete information. Second, Hispanic ethnicity, which may confound the white-black comparison, was not considered. Third, comorbidities, which can affect the use of treatment and are known to vary by race,^{33,34} were not considered. Furthermore, the potential confounding effects of demographic factors, tumor characteristics, and comorbidities were not considered simultaneously.

The objective of the current study was to use data from both the cancer registry and the medical claims system of the MHS to examine colon cancer treatment among non-Hispanic white (NHW) and non-Hispanic black (NHB) beneficiaries. We aimed to assess whether racial disparities in colon cancer surgery and chemotherapy exist in an equal-access health care system; we simultaneously controlled for all of the available potential confounders, including ethnicity and comorbidities, and assessed whether the relationship between race/ethnicity and treatment varied by age at diagnosis, sex, or tumor stage.

MATERIALS AND METHODS

Data Source

This project used consolidated data from 2 sources, the DoD Central Cancer Registry (CCR) and the MHS Data Repository (MDR). Both data sources contain information from DoD beneficiaries, including active duty members, retirees, National Guard and Reserve members, and their dependents. The CCR includes all of the cancer cases that are diagnosed and/or treated at military treatment facilities, and information is abstracted from patient records and entered into the CCR database by certified cancer registrars. The CCR contains data on demographics (age, sex, race/ethnicity, and marital status), tumor characteristics (stage, grade, and histology), screening, treatment (eg, surgery, chemotherapy, and radiation), and

diagnosis. The MDR contains administrative and medical care claims data (ie, information on clinical diagnoses, diagnostic procedures, prescription medications, and treatment) for inpatient and outpatient services that are provided directly at military treatment facilities or paid for by the DoD at civilian facilities.

The project on which this analysis was based was reviewed and approved by the institutional review boards of the Walter Reed National Military Medical Center, Tri-care Management Activity, and the National Institutes of Health Office of Human Subjects Research.

Study Population

Patients with colon adenocarcinoma were eligible for this study. The initial study population included 3311 patients (1960 men and 1351 women) who were diagnosed with histologically confirmed colon cancer between 1998 and 2007 in both the CCR and MDR. Tumors that were solely reported via death certificate or autopsy were not included. Patients who were neither NHW nor NHB ($n = 644$), did not have an adenocarcinoma histology ($n = 97$), or had in situ tumors ($n = 10$) were excluded from the study.

Study Variables

Demographic variables were obtained from the CCR unless the values were missing, then supplemental data from the MDR were included. Values missing in both the CCR and MDR were classified as unknown. Race was categorized into 2 mutually exclusive groups on the basis of the definitions used in the 2000 US Census and was classified as NHW and NHB. Marital status at diagnosis was classified as never married, married, other (separated, divorced, or widowed), and unknown. Beneficiaries were classified as either active duty or nonactive duty (ie, retiree and dependent) at the time of diagnosis. Affiliated service branch was categorized as Army, Air Force, Marines, Navy, other (ie, Coast Guard or Public Health Service), and unknown.

Tumor characteristic data were obtained from the CCR. Tumor stage at diagnosis was defined according to the American Joint Committee on Cancer staging recommendations and was categorized as stage I, stage II, stage III, and stage IV.³⁵ Tumor grade was classified into 4 categories, by level of differentiation, including well differentiated, moderately differentiated, poorly differentiated, and unknown.³⁵ Colon cancer sites included cecum (C180), ascending colon (C182), hepatic flexure (C183), transverse colon (C184), splenic flexure (C185), descending colon (C186), sigmoid colon (C187), and unknown/colon, not otherwise specified (C188-C189).

Treatments compared were determined according to the National Institutes of Health clinical guideline that does not indicate radiation treatment for patients with colon cancer;³⁶ thus, receipt of radiation was not assessed in

this study. The receipt of colon cancer surgery and chemotherapy was determined by combining the CCR and MDR data and was considered “yes” if either database recorded their occurrence within 12 months postdiagnosis. Yes/no concordance between the CCR and MDR was 88% for surgery and 82% for chemotherapy.

Comorbidities were considered present if a diagnosis based on the International Classification of Diseases, ninth revision, codes was recorded in inpatient and/or outpatient MDR data during the year before colon cancer diagnosis; to reduce the possibility of false diagnoses, a comorbidity had to be recorded in the data at least 3 times. The level of comorbidity for each individual was calculated on the basis of the Charlson comorbidity index,³⁷ excluding colon cancer diagnosis, and was categorized as having a weighted comorbidity of 0, 1, or ≥ 2 .

Statistical Analysis

χ^2 tests of significance were used to compare demographic, tumor, and health characteristics, as well as colon cancer treatment, between the 2 racial groups. Logistic regression was used to control for potential confounders in assessing the associations between race and the receipt of colon cancer surgery or chemotherapy. Variables that are associated with both race/ethnicity and treatment or could possibly confound results were adjusted for in regression analyses. These variables included age at diagnosis, sex, marital status, active duty status, service branch, tumor stage, tumor grade, colon cancer site, presence of comorbidities, and recurrence. Regression analyses were conducted both overall and stratified by age at diagnosis (<50 years, 50–64 years, or ≥ 65 years), sex, and tumor stage. The ages of 50 and 65 years were chosen as cutoff points, because 50 years is the age recommended for colon cancer screening³⁸ and 65 years is the age eligible for Medicare coverage.³⁹ Individuals with Medicare may visit medical facilities that are not covered by the MHS, and the data completeness may vary by race/ethnicity. ORs and 95% CIs were calculated. All of the statistical analyses were performed using SAS software, version 9.3 for Windows (SAS Institute, Inc, Cary, NC). All of the significance tests were 2 sided and performed at an α of 0.05.

RESULTS

A total of 2560 patients were included in the study (2047 NHWs and 513 NHBs). Racial differences in demographics and tumor characteristics were observed (Tables 1 and 2). Compared with NHWs, at the time of diagnosis, NHBs were more likely to be younger, never married, on active duty, and affiliated with the Army ($p \leq 0.02$; Table 1). In addition, NHBs were more likely than NHWs to be diagnosed with later-stage colon cancer and cancers located in the cecum or descending colon and less likely to have

TABLE 1. Racial comparisons of demographic characteristics among Department of Defense colon cancer cases, 1998–2007

Characteristic	Non-Hispanic white	Non-Hispanic black	<i>p</i> ^a
	(<i>N</i> = 2047)	(<i>N</i> = 513)	
Age at diagnosis, y			<0.01
<50	287 (14)	122 (24)	
50–54	201 (10)	65 (13)	
55–59	258 (13)	65 (13)	
60–64	375 (18)	94 (18)	
65–69	232 (11)	67 (13)	
70–74	233 (11)	47 (9)	
75–79	202 (10)	31 (6)	
≥80	259 (13)	22 (4)	
Sex			0.92
Men	1254 (61)	313 (61)	
Women	793 (39)	200 (39)	
Marital status at diagnosis			0.02
Never married	56 (3)	27 (5)	
Married	1563 (76)	378 (74)	
Other	342 (17)	91 (18)	
Unknown	86 (4)	17 (3)	
Active duty status at diagnosis			<0.01
No	1895 (93)	447 (87)	
Yes	152 (7)	66 (13)	
Service branch ^b			<0.01
Army	667 (33)	256 (50)	
Air force	690 (34)	130 (25)	
Marines	85 (4)	19 (4)	
Navy	470 (23)	81 (16)	
Other	22 (1)	4 (1)	
Unknown	113 (6)	23 (4)	

N = 2560.

^aData show 2-sided *p* value.^bData include the service branch of active duty member or sponsor.

cancer in the sigmoid colon ($p < 0.01$; Table 2). Tumor grade, level of comorbidity, and recurrence did not differ significantly by race.

Univariate analysis revealed racial differences in colon cancer treatment overall and/or when stratified by demographic characteristics (Table 3). No differences in surgery were seen among NHWs and NHBs overall; however, racial differences were seen at age at diagnosis, with younger NHBs undergoing surgery less frequently than NHWs ($p = 0.04$). Racial differences in chemotherapy were observed overall and by sex in univariate analyses. Overall, NHBs were more likely than NHWs to receive chemotherapy ($p < 0.01$). However, this difference was seen only among men ($p < 0.01$). After controlling for demographic, tumor, and health characteristics, the odds of receiving surgery or chemotherapy were similar between NHWs and NHBs (Table 4). In addition, racial differences in the receipt of chemotherapy did not vary by age at diagnosis, sex, or tumor stage. Stratified analyses were not conducted for surgery, because almost all of the NHBs underwent surgery for certain strata.

TABLE 2. Racial comparisons of tumor and health characteristics among Department of Defense colon cancer cases, 1998–2007

Characteristic	Non-Hispanic white	Non-Hispanic black	<i>p</i> ^a
	(<i>N</i> = 2047)	(<i>N</i> = 513)	
Tumor stage			<0.01
I	504 (25)	92 (18)	
II	500 (24)	111 (22)	
III	552 (27)	152 (30)	
IV	309 (15)	109 (21)	
Unknown	182 (9)	49 (10)	
Tumor grade			0.32
Well differentiated	321 (16)	67 (13)	
Moderately differentiated	1295 (63)	342 (67)	
Poorly differentiated	293 (14)	66 (13)	
Unknown	138 (7)	38 (7)	
Colon cancer site			<0.01
Cecum	437 (21)	117 (23)	
Ascending colon	407 (20)	96 (19)	
Hepatic flexure	101 (5)	25 (5)	
Transverse colon	166 (8)	47 (9)	
Splenic flexure	68 (3)	34 (7)	
Descending colon	130 (6)	52 (10)	
Sigmoid colon	687 (34)	128 (25)	
Unknown/colon, NOS	51 (2)	14 (3)	
Comorbidities ^b			0.18
0	1217 (59)	328 (64)	
1	275 (13)	62 (12)	
≥2	555 (27)	123 (24)	
Recurrence			0.09
No	1797 (88)	436 (85)	
Yes	250 (12)	77 (15)	

N = 2560; NOS = not otherwise specified.

^aData show 2-sided *p* value.^bComorbidities via the Charlson comorbidity index. Colon cancer was not included in calculation.

DISCUSSION

In this study, we examined racial disparities in colon cancer surgery and chemotherapy among DoD beneficiaries of all stages of disease who have equal access to care. Univariate analysis revealed that, overall, there were no racial differences in surgery but that NHBs were more likely to receive chemotherapy than NHWs. In addition, younger NHWs were more likely to undergo surgery compared with NHBs, whereas NHB men were more likely to receive chemotherapy than their NHW counterparts. However, after multivariate adjustment, the odds of receiving colon cancer surgery or chemotherapy were similar between the 2 racial groups.

Our findings suggest no racial/ethnic differences in the receipt of therapy in MHS beneficiaries. These results are consistent with a previous analysis within the MHS²⁹; however, the current study used not only cancer registry but also medical claims data to provide more complete treatment information and considered potential effects of additional factors that could influence the receipt of treatment

TABLE 3. Racial comparison of colon cancer treatment among Department of Defense colon cancer cases, 1998–2007

Parameter	Treatment	Non-Hispanic white	Non-Hispanic black	<i>p</i> ^a
		(<i>N</i> = 2047)	(<i>N</i> = 513)	
		Yes (%)	Yes (%)	
All study subjects	Surgery	1995 (97)	496 (97)	0.33
	Chemotherapy	940 (46)	273 (53)	<0.01
Tumor stage I	Surgery	503 (100)	92 (100)	0.67
	Chemotherapy	12 (2)	5 (5)	0.11
II	Surgery	498 (100)	111 (100)	0.50
	Chemotherapy	184 (37)	47 (42)	0.28
III	Surgery	551 (100)	151 (99)	0.33
	Chemotherapy	447 (81)	124 (82)	0.87
IV	Surgery	300 (97)	105 (96)	0.70
	Chemotherapy	231 (75)	81 (74)	0.93
Age at diagnosis, y <50	Surgery	284 (99)	117 (96)	0.04
	Chemotherapy	209 (73)	92 (75)	0.59
50–64	Surgery	822 (99)	219 (98)	0.42
	Chemotherapy	448 (54)	124 (55)	0.66
≥65	Surgery	889 (96)	160 (96)	0.91
	Chemotherapy	283 (31)	57 (34)	0.36
Sex Men	Surgery	1216 (97)	303 (97)	0.88
	Chemotherapy	552 (44)	163 (52)	<0.01
Women	Surgery	779 (98)	193 (97)	0.13
	Chemotherapy	388 (49)	110 (55)	0.12

N = 2560.

^aData show 2-sided *p* value.

(eg, Hispanic ethnicity and the presence of comorbidities). In a previous study within the Veterans Affairs health care system,³⁰ which is another equal-access system, there were also no differences in the receipt of colon cancer treatment between white and black patients. Findings of these studies in an equal-access system contrast those of previous studies in the general population that have found that blacks are less likely to receive surgery and chemotherapy compared with whites.^{8,9,12,13} Accessibility to medical care may play a role in the receipt of disproportionate treatment among whites and blacks in these studies. For example, in a population-based study that examined the effects of race on use of surgery, lack of health insurance and use of Medicaid resulted in decreased receipt of surgical resection among blacks.⁹ In the MHS, all of the beneficiaries receive health care without charge or for a minimal fee regardless of racial/ethnic background, and, thus, access to care is equal among various racial/ethnic groups. These findings in an equal-access system suggest that racial variations in colon cancer treatment observed in the general population likely result mainly from different levels of access to health care, which may affect treatment received.

Beyond access to care, physician treatment recommendations,^{16,17} patient-provider communication,^{20,21} patient-physician race concordance,⁴⁰ shared decision making with family and friends,^{22,23,34,35} and patient knowledge, attitude, and beliefs on cancer^{18,19} may also be related to

the racial differences in colon cancer treatment observed in the general population. However, similar treatment use among MHS beneficiaries in this study suggests that these factors may not be substantially different between racial

TABLE 4. Multivariate regression analyses assessing race and the odds of treatment among all of the study subjects and by tumor stage, age, and sex

Parameter	OR ^a	95% CI ^a
Surgery, all subjects	0.75	0.37–1.53
Chemotherapy, all subjects	0.79	0.59–1.04
Tumor stage		
I	2.52	0.64–9.98
II	0.98	0.61–1.60
III	0.55	0.30–1.00
IV	0.80	0.40–1.58
Age at diagnosis, y		
<50	1.10	0.47–2.59
50–64	0.74	0.48–1.15
≥65	0.93	0.60–1.44
Sex		
Men	0.80	0.56–1.14
Women	0.74	0.45–1.22

N = 2560.

^aORs and 95% CIs of race (non-Hispanic black versus non-Hispanic white) and treatment after adjusting for race, year of diagnosis, age at diagnosis (continuous), sex, marital status at diagnosis, active duty status at diagnosis, service branch of active duty member/sponsor, colon cancer site, tumor stage, tumor grade, surgery, chemotherapy, recurrence, and comorbidities. Respective treatments and stratified variables were not included in stratified analysis.

and ethnic groups. As a result, it is possible that patient and physician factors may not play a crucial role when access to medical care is equal and treatment is available. Thus, it is likely that racial disparities in colon cancer treatment can be reduced through equal access to care.

Although this study had strengths in using more complete treatment data and considering the potential effects by ethnicity and comorbidities, there were also some limitations. DoD beneficiaries with supplemental health insurance may obtain health care services that are not paid for by the DoD; thus, our treatment data may not have been complete. However, during sensitivity analysis, when data were confined to DoD beneficiaries with TRICARE Prime, a health care program provided by the DoD in which beneficiaries receive free care or pay minimal fees for services in a health maintenance organization–like setting and are thus less likely to receive health care services not paid by the DoD, no differences in the receipt of colon cancer treatment were observed between NHWs and NHBs regardless of age at diagnosis, sex, and tumor stage (data not shown). Therefore, it appears that incomplete treatment information might not have substantially affected our results. Accurate timing and duration of chemotherapy and surgery could also not be calculated in this study because only the starting and ending month and year (rather than day) of a treatment were available based on the approved institutional review board protocol. Therefore, our results should be tempered with potential caution because similar treatment frequencies between the different racial groups may, but do not necessarily, mean that the different racial groups received treatment in a comparable manner in terms of treatment timing and duration. Furthermore, our study did not address whether black and white patients differed in terms of the interval between diagnosis and treatment and the frequency and duration of chemotherapy. As a result, further research is warranted.

CONCLUSION

In a health care system in which NHWs and NHBs have the same level of access to medical care, racial disparities in the receipt of colon cancer surgery and chemotherapy were not apparent. Our study suggests the possibility that unequal access to care plays a major role in the racial disparities seen in colon cancer treatment in the general population.

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